square pixel formats, an important characteristic for facilitating interoperability with computers. ¹⁶ What's more, the SDTV transmission formats proposed by the Advisory Committee also stress progressive scan, comprising nine of the twelve SDTV formats in the ATSC DTV Standard. ¹⁷ This means broadcasters and others can easily use progressive scan transmission formats for program material where it offers better performance, or for applications that use text and graphics, or for other video that is likely to be viewed on computers.

In the second place, most of these parties confuse *transmission* formats with *display* formats that will be implemented in receivers. In a digital system, transmission and display formats are no longer linked and need not be the same. The expressed concerns center on display formats, yet it is the transmission standard and not a display standard that is at issue before the Commission. Some recognize this, but argue that transforming interlaced signals into progressive signals at the receiver is an imperfect and expensive solution. These concerns regarding interlaced transmission formats are greatly overstated. Advisory Committee tests of the Grand Alliance prototype system have conclusively demonstrated that de-interlacer performance is essentially transparent, and the cost of receiver de-interlacers was a concern of several parties in the Advisory Committee process until a cost study undertaken by the Advisory Committee concluded that the concern was unwarranted. On the several parties in the Advisory Committee tests of the Concern was unwarranted.

¹⁶"Square pixels" means that picture elements are equally spaced in the vertical and horizontal direction, a condition that simplifies computer processing of images.

¹⁷Thus, 14 of the 18 DTV formats are progressive scan formats.

¹⁸On June 25, 1996 Lucent Technologies and Mitsubishi announced an agreement to develop a set of semiconductor chips that will perform all of the functions needed for next-generation high-definition television sets for the U.S. market. One of the five application-specific integrated circuits being developed is a display processor, which transforms decoded video signals into various display formats.

¹⁹See Record of Test Results, digital HDTV Grand Alliance System, October 1995, at page III - 45.

²⁰One of the members of ATSC has worked with a major computer manufacturer to develop a single integrated circuit that converts among a wide variety of current video formats, including the ATSC DTV Standard formats. This chip has shown superb performance in private demonstrations, and will soon be announced publicly.

²¹Perhaps understanding that even if all transmission formats were progressive, some consumers might still find interlaced displays attractive, some but not all of the members of the computer industry raising these

Finally, although the Grand Alliance generally agrees that progressive scan is the preferred mode for text and graphics material, we do not agree that interlaced scanning is inadequate for services involving computer-based information, even where signals are transmitted and displayed in interlaced format. Perhaps because the computer industry in the past has often rendered text and graphics inadequately by not including proper anti-aliasing techniques, interlaced scan has been given a bad reputation with them. As our demonstration at the Commission's December 1995 En Banc Hearing conclusively showed, the quality of text that is compressed, transmitted, and displayed all in interlaced format can be excellent. Moreover, several computer companies have recently announced joint ventures involving the provision of information services using DBS and other television delivery media. These ventures all utilize interlace scan, and presumably offer acceptable performance.²²

Ignoring the benefits that interlaced scanning can provide for many types of traditional television programming would unduly limit applications of proven importance to broadcasters and viewers. For the vast amount of archival video material originally produced using interlaced scanning, broadcasters will generally find it more efficient to transmit using an interlaced format, and during the transition period broadcasters may prefer an interlaced transmission format for some DTV/NTSC simulcast material. While interlace scanning may not be optimum for computer text and graphics applications, it can deliver good performance for such applications if implemented correctly. Indeed, in today's analog television system,

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complaints have called for the Commission to ban interlace formats in all ATV displays. This proposal violates a long-standing, widely supported computer industry policy opposing government regulation of the features of consumer electronics products. Moreover, banning interlace displays would deprive consumers of the option to purchase less expensive receiver models using such displays, an option that may be attractive to many consumers.

²²Compaq and Thomson Consumer Electronics recently announced joint development of a TV/PC product, illustrating that even the analog, interlaced NTSC transmission standard is not an overwhelming impediment to the potential convergence between PCs and television receivers. Further, Microsoft and DirecTV have announced their cooperation for the delivery of computer content via the DirecTV DBS system, again showing that the predominant use of interlaced formats in the DirecTV system has not proven to be a barrier to TV and computer company collaboration to deliver content. Yet, notwithstanding these examples, if the use of progressive scanning in DTV is as advantageous as many believe, including several members of the Grand Alliance, a marketplace preference for progressive scan formats can be established without the Commission mandating their exclusive use.

interlaced scanning delivers text and graphics required for broadcast programs effectively every day. Interlaced scanning has a long track record of proven value and successful use in traditional television broadcasting, and it has many staunch defenders. In addition, broadcasters must be concerned about the interoperability of a DTV transmission standard with currently available HDTV production equipment and with the installed base of NTSC production and studio equipment, virtually all of which employ interlaced scanning. Furthermore, in the case of SDTV formats, where multiple programs will be simultaneously transmitted over a 6 Mhz channel, the flexibility to use interlaced scanning will generally permit more simultaneous programs to be carried than if the exclusive use of progressive scanning were mandated.²³ Thus, the proponents of increased community service and educational programming should strongly support the inclusion of interlaced formats in the DTV standard, since their use will increase the capacity to deliver such programming in a practical, local broadcasting environment.²⁴

In evaluating pleas to ban interlaced transmission formats from the ATSC DTV Standard, the Commission must bear in mind that with today's technological limitations such an action would mean that a 720-line format would be the only format for HDTV live video programs. There is a substantial body of broadcasters and others who believe that a high-definition format must have more than 1,000 lines to be successful. Any action to eliminate the 1080-line interlaced HDTV format from the proposed standard would cause a major loss

²³The greatest amount of programming could be carried if all of the programs were 24-frames-per-second film sources, in which case a progressive scanning transmission format would be used. However, as a practical matter, much of the educational and community oriented programming is and will continue to be produced and archived in 60 Hz interlaced format, due to the ready availability and low cost of interlaced broadcast equipment. Indeed, the greatest diversity of programming will come about by removing cost barriers to the production of content. In this regard, it is notable that the inclusion of interlaced SDTV formats in the ATSC DTV Standard enables even the use of current consumer electronics equipment such as camcorders and VCRs to support the production of programming for which large professional equipment budgets are not available.

²⁴Accordingly, William Schreiber is mistaken in claiming that the introduction of a progressive scan HDTV camera removes the last remaining argument for including an interlaced format in the digital broadcast television standard. (See letter of William F. Schreiber to Chairman Hundt, May 9, 1996.) While the introduction of such a product is an important and welcome development, it does not negate the substantial benefits, outlined above, of including interlaced scanning formats in the ATSC DTV Standard.

of industry support for the overall DTV proposal. Moreover, it is extremely ironic that the proposed ATSC DTV Standard is the *only* digital television development effort in the world that stresses progressive scan and square pixels. If the Commission were to delay adoption of the Advisory Committee recommendation out of a concern over a limited amount of interlaced scanning, it would only serve to entrench interlaced scanning as the predominant mode for digital television throughout the world.²⁵

Regardless of the technical arguments about the acceptability of interlaced formats for certain classes of applications, continued insistence on banning interlaced formats is unwarranted. The ATSC DTV Standard contains numerous progressive scan and square pixel formats to support the applications that benefit from those attributes. Neither program producers, broadcasters, nor consumers will be forced to use an interlaced format simply because it exists in the standard. On the other hand, there is no doubt that broadcasters will transmit tremendous amounts of material using progressive scan -- motion pictures and most prime time programming at a bare minimum. And for non-film-based video, if judged superior by the marketplace, the use of progressive scan transmission formats will surely proliferate. Likewise, progressive scan displays will predominate among consumers if they offer better price/performance characteristics. Indeed, the members of the Grand Alliance who manufacture televisions already plan to include progressive scan displays in their initial HDTV

²⁵In response to the development of all-digital HDTV broadcast systems in the U.S. first announced in 1990, the Digital Video Broadcasting ("DVB") Project was formed in Europe in 1993 and has since developed a family of digital television standards for satellite, cable, terrestrial and other delivery media. The project has expanded around the world, and now has over 200 members in 29 countries, including Apple Computer and many other U.S. computer, telecommunications, and consumer electronics companies. DVB Satellite services began in 1995 and are currently being used in Europe, Africa, Asia, North America and Australasia. DVB Cable services commenced operation in Europe and Australia in 1995, and DVB Terrestrial services are expected to begin in 1997 in Europe. Current DVB standards focus on SDTV, using interlaced scanning formats and non-square pixel arrays. Likewise, efforts to date to develop and offer satellite and cable digital television services in the U.S. have focused on SDTV, using interlaced scanning and non-square pixel arrays.

26 As Chairman Wiley noted in his December 1995 En Banc Hearing testimony, "Fortunately, the Grand Alliance technology is flexible enough to incorporate both scanning modes in the standard (at minimal additional cost). There was overwhelming consensus for this approach, which reasonably meets the needs of all affected parties. Conversely, there was absolutely no record of support for dropping either mode." (emphasis in original)

product offerings, and some broadcasters have stated that they are leaning toward the use of progressive scan transmission formats for HDTV.²⁷

Some members of the computer industry have also complained about the 60 Hz transmission rate, again confusing transmission formats with display formats. For example, Apple states "... the proposed transmission rate of 60 Hz is of particular concern. A 60 Hz display rate has not proven to be sufficient for the display of text and fine graphic information with the resolution expected by computer users." These complaints are unwarranted from any perspective.

From a broadcaster and regulatory perspective, a 60 Hz transmission rate is certainly adequate to ensure smooth motion rendition in transmitted signals, which is the extent to which a transmission standard should concern itself with either source or display picture refresh rates. Further, the adoption of a higher frame rate than 60 Hz would have to come either at the expense of reduced spatial resolution or increased compression artifacts in order to continue to fit the coded signals within a 6 Mz terrestrial channel, neither of which is a desirable alternative.

From a television receiver perspective, a 60 Hz display rate is not a problem for traditional television viewing of typical motion video material, which will continue to comprise the bulk of DTV viewing use. Further, a 60 Hz display rate is not likely to be a problem for still images with text and fine graphic information, given the greater viewing distances and lower lighting levels that are associated with a television viewing environment (as opposed to an office/desktop environment).

From a computer perspective, computers (or televisions used in computing applications) are not prevented from using conversions to display the transmitted signal at any

²⁷ABC has expressed a tentative preference for progressive scan transmission, however, ABC sees value in the interlaced formats, especially for transmitting material from the immense archives of video originally produced with interlaced scanning. ABC strongly supports rapid adoption of the ATSC DTV Standard, including all of the formats contained therein.

²⁸See Comments of Apple Computer on the <u>Fourth NPRM</u> at 7 (emphasis added).

desired rate. For still pictures, the screen can easily be refreshed at any high rate desired, as is done today. For the display of motion video in a computer, it is possible easily and accurately to convert 60 Hz DTV signals into a 72 Hz display rate by employing the same frame rate conversion techniques commonly used to convert 50 Hz PAL and SECAM television around the world to 60 Hz NTSC television used in North America and Japan.²⁹ Further, motion pictures and the majority of prime time programming are produced in 24-frames-per-second film, which in DTV will be transmitted directly at the 24 Hz rate, which is easily converted to a 72 Hz display rate. (Indeed, the simplicity of this conversion is the motivation for the selection of 72 Hz by its proponents.)

Finally, in all events, the Commission should not regulate the features or performance of displays, as the computer industry has long held.

The Commission's overriding goal in this proceeding is to preserve and enhance free over-the-air television service, including the adoption of policies that will allow digital television infrastructure and applications to contribute to improving the NII. Contrary to the implicit assumption of some members of the computer industry, the Commission's goal is not and should not be to legislate a transformation of the digital HDTV receiver -- already the most computer-friendly, interoperable entertainment/NII appliance ever developed -- into a personal computer.

B. Aspect Ratio

Some cinematographers have objected to the 16:9 aspect ratio included in the ATSC DTV Standard, saying that it will limit broadcasters' ability to display the full artistic quality of their work. As explained fully in the August 28, 1995 letter of Stanley Baron, President of the Society of Motion Picture and Television Engineers, and also head of the ATSC Technology Group on Distribution (T3), this decision was reached more than a decade ago after extended and careful deliberations with extensive participation by the motion picture and television

²⁹Conversion from 60 to 72 Hz requires a 5:6 frame rate conversion, the same as required for the conversion of 50 to 60 Hz. (i.e., 60:72 = 50:60 = 5:6).

production community. The final 16:9 ratio (1.78:1) was in fact wider than the 5:3 ratio originally sought by the electronics manufacturing industry, and utilizes three-quarters of the total screen height for 2.4:1 material (the widest of commonly used motion picture aspect ratios) and three-quarters of the screen width for 4:3 material (the standard NTSC format).

The 16:9 aspect ratio has been adopted in a variety of international standards bodies, and manufacturers around the world have been building CCD sensing arrays, camera lenses, production equipment, picture tubes, and widescreen receivers in the 16:9 format for years. Because of the wide variety of aspect ratios used by the motion picture industry in the U.S. and throughout the world, and because an aspect ratio wider than 16:9 is not ideal for some other types of programming such as newscasts and one-on-one interviews, it is impossible to select a single aspect ratio that perfectly satisfies every need. However, as Mr. Baron's letter makes clear, it has been demonstrated that there is no difficulty in accommodating program material or motion picture films of any reasonable aspect ratio within the 16:9 format either for production, post-production, distribution or display. Changing the aspect ratio for broadcast DTV at this late date would cause unacceptable and unnecessary delays in implementing DTV service, and would severely damage many parties who have already made significant investments leading to DTV service.³⁰

C. Interoperability with Cable and Other Delivery Media

Although the Advisory Committee's charter was to recommend a terrestrial broadcast ATV transmission standard, from the beginning the easy interoperability of the broadcast ATV standard with cable TV systems was a key objective in the development of the Grand Alliance system and the ATSC DTV Standard. Indeed, the Grand Alliance developed and evaluated high-data-rate modes, i.e., 16-VSB and 256-QAM, for possible use in cable and other transmission environments that can support higher data rates than terrestrial broadcast.

³⁰See Mark Shubin, "The History of the Perfect Aspect Ratio," <u>Proceedings of the 137th SMPTE Technical Conference and World Media Expo.</u> September, 1995, finding, *inter alia*, that there is no perfect aspect ratio, but if there were, it would be 16:9; that the 16:9 ratio has already been chosen and is in use around the world; that 16:9 should only be changed for compelling reasons and his research has found none.

This capability would be utilized to deliver approximately twice the payload capacity achievable over 6 MHz terrestrial channels. Accordingly, such capabilities could support, for example, two simultaneous live-action HDTV sports programs over a single 6 MHz cable channel

Throughout the nine-year Advisory Committee process, the cable industry has made significant investments and contributions to ensure the suitability of the standard for carriage over cable systems. A significant portion of the Advisory Committee's laboratory and field tests were conducted by Cable Television Laboratories, Inc. ("CableLabs"), including testing of the selected 16-VSB mode. The testing focused on ensuring that the digital HDTV system developed for terrestrial broadcast would also meet the needs of the cable industry. As a result, the Grand Alliance members believe that as voluntary standards activities continue in the cable industry, as well as for DBS, MMDS and ITFS services and for open video systems, it is likely that many elements of the terrestrial ATV standard will also be incorporated in emerging standards in these industries.³¹ We believe that such voluntary standards will promote the early availability of digital television, including HDTV, over all of these other media as well as terrestrial broadcasts, without causing undue burdens on cable operators or other providers. Indeed, the ability of these other competitive delivery media to introduce compelling new technologies without FCC review and approval will continue to provide pressure to ensure that universal broadcast television service implements the technology required to remain responsive to consumer needs.

³¹The Society of Cable Television Engineers has recently launched a digital television standards engineering subcommittee, and the ATSC has broadened its efforts to promote interoperability of its standards with other media.

VI. Other Issues

A. Receiver Standards

In the NPRM at ¶66 the Commission inquires whether it should require that receivers (and set-top boxes designed to receive ATV broadcasts for display on NTSC sets) be able to receive adequately all DTV formats. In our comments on the <u>Fourth NPRM</u>, uniformly echoed by the receiver manufacturers who filed comments, we stated our belief that marketplace forces would dictate that all DTV receivers (and set-top converters) would be capable of *receiving* all DTV formats, without any government requirement to do so, although some lower-end receivers might well *display* high-definition signals in a lesser resolution format.³² In comments on the <u>Fourth NPRM</u> and in public comments that have followed, including Congressional testimony, broadcasters have made clear that they intend to broadcast substantial amounts of HDTV programming over their DTV channels. It would be foolhardy for any manufacturer to offer digital sets in the marketplace that go dark for any programming, much less a substantial amount of broadcast programming. Consequently, the Commission need not and should not impose a requirement that all digital receivers and converters receive all of the formats in the ATSC DTV Standard.

With respect to other aspects of the reception performance of receivers, the same marketplace forces that operate today to ensure that television manufacturers provide adequate reception performance will continue to motivate manufacturers to compete to provide high-quality receivers. If it is determined that any minimum performance levels need to be established for DTV receivers, they should be the subject of voluntary industry standards, just as they have been with the current analog system for many years.

³²At ¶66, the NPRM cites concerns that an all-format reception requirement might have a large effect on either reception quality or receiver costs, somehow attributing these concerns to the Electronic Industries Association and its Advanced Television Committee (EIA/ATV) and to Zenith Electronics Corporation. In fact, neither EIA/ATV nor Zenith expressed any such concerns, but both parties expressed the belief that digital sets would receive all of the digital formats without any Commission mandates. (See Fourth NPRM Comments of EIA/ATV at 15 and Comments of Zenith at 4.)

B. Licensing of Technology

As the Commission notes in \$67 of the NPRM, the Advisory Committee process required that the proponents of any DTV system ultimately selected agree to license under reasonable and nondiscriminatory terms the technology necessary to implement the standard. The Grand Alliance members support the Commission's objective to make this technology broadly and rapidly available, and each Grand Alliance member has given the ATSC a written commitment to abide by this requirement. We don't perceive any particular issue with pending patents -- whenever any Grand Alliance member's technology necessary to implement the standard becomes patented, it will fall within the commitment to license on reasonable and nondiscriminatory terms. The Grand Alliance members are not aware of any problems that would require the Commission to take further action to ensure easy and nondiscriminatory access to the intellectual property necessary for a rapid implementation of the ATSC DTV Standard.

C. International Trade

As the Commission has noted (NPRM, ¶68), in developing the specifications for the combined "best-of-the-best" system, the Grand Alliance and the Advisory Committee took great pains to maximize compatibility with international standards, including the use of MPEG-2 video compression and MPEG-2 transport. Providing compatibility for these two elements of the standard is most important in providing a high degree of international interoperability. It is less important and less likely that some other aspects of the system, such as the modulation scheme and the picture refresh rate be common among all nations or regions. In addition to establishing these structural commonalities in compression and transport, expeditiously authorizing a single DTV standard for use in the United States will enhance the export opportunities of U.S.-based content providers and equipment manufacturers, because the focus by broadcasters, manufacturers and consumers on a single well-defined standard will promote a rapid introduction of the service, which in turn will promote its use in other countries around the world. Indeed, the most important thing the

Commission can do to facilitate international compatibility and promote export opportunities is to adopt the ATSC DTV Standard as rapidly as possible.

The Grand Alliance members support the recent initiatives by the ATSC to promote the use of the ATSC DTV Standard beyond the United States, especially throughout the Americas. We believe that the ATSC DTV Standard represents the best digital television technology in the world, fully encompassing both HDTV and SDTV as well as a host of other applications, and offers by far the best interoperability with computers and telecommunications, through its use of a packetized data transport structure and its emphasis on progress scanning and square pixels. Yet, while this superior system awaits final approval from the Commission, the European DVB system -- which presently implements only SDTV using interlaced scanning and non-square pixels exclusively -- has been adopted and mandated in Europe and is being heavily promoted around the world, and has even been selected for use in some U.S. DBS services. Moreover, efforts to promote the ATSC DTV Standard for use elsewhere in the world encounter the obvious obstacle that it still has not been adopted for terrestrial television in the U.S.³³

Just as certainty and reliability are required to galvanize the industry toward implementing digital broadcast television, such certainty and reliability are necessary to motivate other countries to utilize the ATSC DTV Standard for terrestrial television, or to motivate parties here and abroad to implement all or part of the standard for nonterrestrial applications. Notwithstanding the broad industry consensus supporting the ATSC DTV Standard, any further delays by Congress or the Commission threaten to squander the

³³One bright spot has recently developed in this otherwise discouraging international scene. Following the Commission's tentative decision in this proceeding to adopt the ATSC DTV Standard, in June 1996, the Digital Audio/Visual Council ("DAVIC") selected the ATSC DTV video and audio specifications as the basis for the DAVIC 1.2 standard for "higher quality video and audio." DAVIC is a non-profit association based in Geneva, Switzerland, with more than 200 member companies in more than 25 countries, aimed at promoting the success of digital audio/visual applications and services based on specifications that maximize interoperability across countries and across applications and services. Further success in promoting the ATSC DTV Standard in DAVIC and in other international settings will require continued clear signals and expectations that the standard will indeed be formally adopted by the Commission for use in the U.S.

technological lead that the U.S. fought so hard to achieve and see the U.S. "re-leap-frogged" in exploiting this innovative American-born technology.

D. Captioning

Over the course of the last several years, the Advisory Committee worked closely with the affected communities to ensure that closed captioning needs were fully addressed in the standard to be proposed to the Commission so that receiver manufacturers could reliably build closed captioning capability into their ATV receiver designs. We believe that the proposed ATSC DTV standard fully provides all the capability necessary for broadcasters and receiver manufacturers to provide closed captioning.

VII. Conclusion

The ATSC DTV Standard based on the Grand Alliance HDTV system represents by far the world's best digital broadcast television system, with unmatched flexibility and unprecedented ability to incorporate future improvements. Implementing this technology will dramatically raise the technical quality of broadcast television, helping to preserve for consumers and for our democratic society the benefits of a vibrant and healthy free over-the-air television service in the years and decades to come. In addition, deploying this technology will enable consumers to access a host of potential information services that can help meet pressing needs in health, education and other aspects of our society, and will create and preserve tens of thousands of high-skill, high-wage jobs and engender substantial economic growth for our nation.

Over the past decade, the Commission has championed a unique process, providing policy direction and support, while relying on private investment, competition and a volunteer army of experts and leaders from the affected industries to develop a stunning technological achievement. Through this open, thorough process, an extremely broad consensus has been achieved throughout the affected industries, delicately balancing the needs of consumers and the various industries involved. In sharp contrast, there is no consensus supporting the changes proposed by the few detractors of the proposed standard.

Now it is time for the Commission to act decisively, to follow through on the commitment it has made to industry repeatedly over the past decade to set a new broadcast television standard. The Grand Alliance members implore the Commission to adopt the full ATSC DTV Standard as swiftly as possible and mandate its use by digital broadcast licensees. In so doing, the Commission will provide the certainty and reliability required by financiers, broadcasters, manufacturers and consumers to unleash the further substantial investments

necessary to bring the benefits of this fertile technology to the American public and to spread those benefits throughout the world.

Respectfully submitted,

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July 11, 1996